

Amendments to the Specification:

Please replace the title with the following:

-- Spray Nozzle and Dental Cleaning System --.

Please replace the paragraph beginning at page 1, line 3, with the following heading and amended paragraph:

TECHNICAL FIELD

This ~~invention~~ description relates to a mouth rinse, a spray nozzle and a dental cleaning system according to the preamble of the independent claims.

Please replace the paragraph beginning at page 1, line 4, with the following amended paragraph:

It is known that the cleaning effect of oral rinses is improved by using special spray nozzles to create liquid jets of a specific configuration. ~~A spray nozzle within the scope of this application can also be understood to be a nozzle for discharging a water jet which is not comprised of individual drops. From EP 0 841 038 A1 there is known~~ discloses an impeller which is arranged in the spray nozzle for rotation about its axis of rotation, being set in rotation by the cleaning liquid that is fed to the impeller. The cleaning liquid passes to the outlet through a duct which is arranged in the impeller at an angle to the axis of rotation. As the result of the rotation of the impeller the cleaning liquid is discharged from the outlet of the spray nozzle in the form of a rotating liquid jet. A single jet is thus created and circulates, evenly distributed, on an expanding cone. In spite of the enlarged effective area, the cleaning effect of a liquid jet created with such a spray nozzle is not optimal as yet. In particular the removal of marginal plaque is possible with such a spray nozzle only to an inadequate degree. Only non-adhering plaque can be removed with the liquid jet of a mouth rinse. The removal of plaque in the approximal region and in the gingival margin is possible only with hand toothbrushes, dental floss or electric

toothbrushes, albeit to an unsatisfactory degree. Another disadvantage of the spray nozzle is the rotating impeller, as moving components are subject to greater wear. The longer the use, the greater the wear, and this leads to an enlargement of the bearings, which in turn can result in a reduction of the impeller's speed and ultimately its stoppage.

Please replace the paragraph beginning at page 1, line 23, with the following amended paragraph:

From DE 199 59 188 A1 ~~there is known~~ discloses a dental cleaning device similar to an oral rinse. In addition to a spray nozzle discharging a cleaning liquid, the device needs a cleaning scraper which is configured as a spoon-shaped auxiliary part. A pressure of 3 to 6 bar and an exit velocity of 5 m/s to 15 m/s are provided for the liquid. It is explained that higher values should be avoided as otherwise the liquid jet is perceived as unpleasant. These values are said to be a good compromise between a high cleaning effect and an intensity of impact that is still perceived as pleasant. It is a disadvantage, however, that the scraper is unable to reach into all interproximal spaces and other regions of the teeth.

Please replace the paragraph beginning at page 1, line 31, with the following heading and amended paragraph:

SUMMARY

~~It is therefore an object of the present invention to provide~~ According to one aspect, a mouth rinse and a spray nozzle for the mouth rinse which afford an improved cleaning effect. The liquid jet should be capable of removing firmly adhering plaque from the approximal region and the gingival margin. The spray nozzle for creating such a liquid jet should work as far as possible without suffering any wear and be of simple construction. Also, a device enabling extensive cleaning of the teeth and the gums should be provided for the spray nozzle.

Please delete the paragraph beginning at page 2, line 5, which starts with "This object is accomplished"

Please replace the paragraph beginning at page 2, line 6, with the following amended paragraph:

According to ~~the invention~~ another aspect, the cleaning liquid is fed at high pressure to a spray nozzle such that a liquid jet comprised of micro-sized drops is discharged at high velocity from a nozzle outlet. In particular the nozzle outlet forms a thin, fast moving liquid film which is then transformed into micro-sized drops moving at high velocity.

Please replace the paragraph beginning at page 2, line 16, with the following amended paragraph:

~~Using the solution of the invention~~ In one or more embodiments of the dental cleaning device, it is possible to dispense with a scraper or other auxiliary part. In particular the microsize of the drops is perceived as relatively pleasant. However, ~~it is basically possible to use in some embodiments~~, the mouth rinse can be used simultaneously in combination with a brush part or other auxiliary part which contacts the teeth directly. The auxiliary part can be constructed as a ring-shaped brush which is arranged concentrically around the nozzle outlet.

Please replace the paragraph beginning at page 3, line 19, with the following amended paragraph:

~~In respect of a~~ In one embodiment, the spray nozzle for creating a liquid jet for a mouth rinse, includes a chamber, with a nozzle member that is provided with a chamber into which extends a liquid duct supplying pressurized cleaning liquid extending into a chamber and supplying pressurized cleaning liquid thereto, and from which a nozzle outlet extending from the

chamber for discharging a cleaning liquid jet ~~extends, it is an advantage.~~ Advantageously, for the chamber ~~to be~~ is connected to a whirl chamber of approximately round cross section for creating a circulating flow of the cleaning liquid, the nozzle outlet extending centrally from said whirl chamber and being comprised of a preferably approximately cylindrical narrow passage and an optionally adjacent, in particular approximately conical, expansion. The expansion can also be omitted or be constructed with a non-conical shape as required.

Please replace the paragraph beginning at page 3, line 28, with the following amended paragraph:

With this construction it is possible to create a liquid jet comprised of micro-sized drops with high velocity, which, owing to the velocity of the drops, is capable of removing dental plaque. A cleaning operation performed with the spray nozzle constructed as a hollow cone nozzle enables in the same period of use a gentler cleaning operation than with an electric toothbrush on account of a distinctly reduced abrasion of the epithelial cell layer. Furthermore, after using an electric toothbrush the spray nozzle of one embodiment provides ~~enables~~ an additional reduction of approximately 60% plaque particularly in the approximal region. The spray nozzle works without any moving parts, which would be subjected to intensive wear.

Please replace the paragraph beginning at page 5, line 5, with the following amended paragraph:

Replaceability of the nozzle attachment ~~is ensured when it is~~ can be configured to detachably connected to the nozzle member for ease of replacement, for example. The detachable connection can be constructed either as a screw connection or as a snap- and push-lock connection, for example, and. ~~The nozzle attachment~~ can thus be replaced, for example in case of damage. At the same time a nozzle member constructed in this fashion enables the

accommodation of conventional nozzle attachments, which are operated with a substantially larger volumetric flow at considerably lower pressure.

Please replace the paragraph beginning at page 5, line 11, with the following amended paragraph:

It has ~~proven to be advantageous~~ Advantageously, the chamber includes for the
~~construction of the whirl chamber to arrange~~ a pressure piece in the spray nozzle to form a whirl
chamber. The pressure piece is arranged in a chamber which is formed between the nozzle attachment and the nozzle member. To fix the pressure piece in the chamber, the part of the pressure piece located in the nozzle member or nozzle attachment is inserted with a press fit or is fixed by means of latching elements arranged on the nozzle attachment or nozzle member. On the one hand this fixing simplifies the mounting, on the other hand the pressure piece is held captive on one of the two parts during any replacement of the nozzle attachment. However, it is also conceivable to hold the pressure piece clamped between the nozzle member and the nozzle attachment through oversize or by means of a spring.

Please replace the paragraph beginning at page 6, line 4, with the following amended paragraph:

The function of the spring arms is assisted when the pressure piece is made of an elastic material, e.g., a plastics material.

Please replace the paragraph beginning at page 6, line 6, with the following amended paragraph:

The arrangement of the whirl chamber in the pressure piece as a separate component guarantees a particularly simple production. The whirl chamber is formed by the interior space

in the first cup-shaped part, which is mounted on the area around the narrow passage, the narrow passage forming the outlet from the whirl chamber. To seal the whirl chamber, the cup-shaped part is seated around the narrow passage. ~~A particularly good sealing effect is achieved when~~ In one embodiment, the cup-shaped part has a planar seating surface. This type of sealing prevents deformations in the pressure piece. Such deformations could occur with a line-shaped sealing arrangement when the cup-shaped part seals with an edge.

Please replace the paragraph beginning at page 6, line 14, with the following amended paragraph:

Furthermore it would also be conceivable to construct the sealing faces as a cone. In this construction, the cone angles of the nozzle plate and the pressure piece are configured ~~have to be~~ exactly in agreement. By contrast, two plane surfaces afford greater economy of manufacture.

Please replace the paragraph beginning at page 6, line 22, with the following amended paragraph:

The access to the whirl chamber is ~~formed~~ provided by at least one opening in the first cup-shaped part, which opening is perpendicular or at an angle smaller than about 90° to the axis of symmetry of the pressure piece. The configuration of the jet has been shown to be influenced by the number, the cross section and the position of the openings. Good results were obtained with two opposite lying openings which are constructed as slits.

Please replace the paragraph beginning at page 6, line 27, with the following amended paragraph:

To create a sufficient whirl in the whirl chamber, the openings lead into the whirl chamber approximately transverse to and centrally offset from the longitudinal axis of the whirl

chamber. The magnitude of the center offset and the angle at which the openings lead into the whirl chamber are likewise decisive for the jet configuration. For example, a center offset big enough for the liquid jet discharged from the openings to impact on the opposite lying wall of the whirl chamber at an angle smaller than about 45° has proven to be favorable. In this angular range the jet is able to transfer its energy to the developing whirl most effectively.

Please replace the paragraph beginning at page 7, line 17, with the following amended paragraph:

If the spray nozzle is arranged on the hand piece of the device so as to be exchangeable for another nozzle, then the device can be operated in various operating modes. The replaceability permits the use of not only the high-pressure spray nozzle ~~of the invention~~ for the removal of dental plaque but also, for example, a conventional jet and/or spray nozzle. The spray nozzle ~~of the invention~~ is operated with a small volumetric flow at a high pressure, and a standard mouth rinse nozzle with a large volumetric flow at a low pressure. If both nozzles are operated with approximately the same hydraulic power, the pump can be driven by one electric motor, with the pump being of the switchable type using, for example, a switchable gear train.

Please replace the paragraph beginning at page 8, line 3, with the following amended paragraph:

In another construction use is made of the fact that, unlike a conventional jet and/or spray nozzle used in mouth rinse mode, the high-pressure mode with the spray nozzle ~~of the invention~~ produces a high torque and a low rotational speed. In this case a rotational speed or torque sensor can be arranged on the pump or on the electric motor in order to detect the rotational speed or the torque of a rotor of the pump or the electric motor, and a signal indicative of the detected rotational speed or the detected torque can be delivered from the rotational speed or torque sensor to a control unit, and the electric motor and/or the pump and/or the gear train can

be controlled by the control unit with the operating mode assigned to the detected rotational speed or the detected torque. It will be understood, of course, that the torque and/or the rotational speed can also be detected by means of a measurement taken of the electric current consumed by the motor. In conclusion it can be said that switching between operating modes is possible by detecting the pressure or the electric current.

Please replace the paragraph beginning at page 8, line 16, with the following amended paragraph:

Particularly advantageous further developments of the mouth rinse ~~of the invention~~, by means of which the mouth rinse can be switched over from ~~the~~ a first operating mode ~~of the invention~~ to a second another operating mode with lower pressure, will be explained in the following. Provision is herein made for an eccentric shaft or a crankpin to be adjustably arranged in their total eccentric dimension on a drive element, with a crank mechanism being provided for a pump of the mouth rinse, and the mouth rinse being provided with a drive element adapted to be driven for rotation about an axis of rotation by a drive device, and with an eccentric shaft or crankpin, which acts as an output and is arranged on the drive element a total eccentric dimension away from and parallel to the axis of rotation.

Please replace the paragraph beginning at page 13, line 9, with the following amended paragraph:

~~In an advantageous embodiment of the mouth rinse of the invention, provision is made for~~ Advantageously, a piston of a pump of the mouth rinse ~~to~~ can be axially slidably and guided in two relatively spaced bearings of the pump housing.

Please replace the paragraph beginning at page 16, line 20, with the following amended paragraph:

~~One possibility of arranging~~ In one embodiment, the seal is ~~for the seal to be~~ fixed in the pump housing and ~~have~~ includes a sealing lip which radially encloses the piston and is in sealing engagement with it.

Please delete the paragraph beginning at page 16, line 26, which starts with “The present invention”.

Please add the following new heading before the paragraph beginning at page 16, line 28:

DESCRIPTION OF THE DRAWINGS

Please replace the paragraph beginning at page 17, line 7, with the following amended paragraph:

FIG. 8 is a sectional view of a first embodiment of an eccentric drive or crank mechanism of the mouth rinse ~~of the invention~~, taken in the plane I-I of FIG. 9;

Please add the following new heading before the paragraph beginning at page 18, line 20:

DETAILED DESCRIPTION

Please replace the paragraph beginning at page 19, line 7, with the following amended paragraph:

The first cup-shaped part 8 has two grooves 12 formed axially on the circumference of the pressure piece 7. In the area of the grooves 12 the cup-shaped part 8 is encompassed by a ring 13. This ring 13, which is can be made of polyamide in one example, seals off the circumference of the cup-shaped part 8 such that the grooves 12 act as ducts. Adjoining the lower end of the grooves 12 and extending radially thereto are ducts 14 formed as slits which extend approximately tangentially into a whirl chamber 15.

Please replace the paragraph beginning at page 19, line 23, with the following amended paragraph:

The cleaning liquid set in rotation in the whirl chamber 15 by the approximately tangential ducts 14 is greatly accelerated in a whirling pattern as the result of the small diameter of the bore 18. The cleaning liquid then enters the hollow cone 19. In the hollow cone 19 the cleaning liquid develops an evenly distributed film over the wall of the hollow cone 19 as the result of the whirling movement and the decompression. At the same time the film rotates about the axis A at high velocity. When the thus moving cleaning liquid reaches the edge 20, the film disintegrates into a multiplicity of drops with an average size of around 10 μm , which move with a velocity of around 50 m/s. The aggregate of the drops disperses from the edge 20 to form a substantially conical pattern ~~forms a hollow cone~~.

Please replace the paragraph beginning at page 21, line 10, with the following amended paragraph:

In use ~~When the spray nozzle 1 of the invention is used~~, the pump 28 generates in high-pressure mode a volumetric flow of 50 ml/min at approximately 40 bar. This is roughly equivalent to a mechanical or hydraulic output of 2,000 ml/min bar, approximately, or 3.3 W, approximately. When a conventional spray nozzle is arranged on the hand piece 31, the sensor 32 detects the changed torque compared with the spray nozzle 1 ~~of the invention~~, and the pump 28 is operated in mouth rinse mode. In this case the pump 28 delivers a volumetric flow of 300 ml/min, approximately, with a pressure of 6 bar. This results in a mechanical or hydraulic output of 1,800 ml/min bar, approximately, or 3.0 W. With the mechanical output in both operating modes being approximately equal, it is possible to operate the device 26 with a pump 28 and an electric motor 29.

Please replace the paragraph beginning at page 29, line 4, with the following amended paragraph:

FIG. 26 shows the segments of a tooth according to “Rustogi”. After just two minutes of cleaning time per dentition with the mouth rinse ~~of the invention~~, more than 70% to 80% of the plaque is removed in the approximal regions (D and F) and in the gingival margins (A, B and C). In the other regions (I, G, H and E) there is an even better cleaning effect. Cleaning also occurs in the proximal regions (spaces between the teeth). In this case the cleaning causes very little abrasion, being very gentle on the teeth.

Please replace the paragraph beginning at page 30, line 1, with the following amended paragraph:

It will be understood that the ~~present invention~~ dental cleaning system is not limited to the examples described. Any combination of the individual features of the various examples is possible. In particular the combination of a mouth rinse according to FIGS. 1 to 7 with an eccentric drive according to FIGS. 8 to 18 and/or with a pump according to FIGS. 19 to 24 is suitable.

Please delete previous abstract at page 36 and add the following new abstract presented below and in Attachment A:

A dental cleaning system for providing a liquid jet for a mouth rinse includes a nozzle member, a nozzle attachment coupled to the nozzle member to define an axially extending chamber, a liquid duct configured to supply pressurized liquid to the chamber, a pressure piece disposed within the chamber, and a nozzle outlet extending out of the chamber and configured to discharge a cleaning jet.